WHAT IS CLAIMED IS:

1. A memory, comprising:

a first recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse; and

a second recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature of the first recording layer, T_{x1}, and the crystallization temperature of the second recording layer, T_{x2}, have the relationship $T_{x1} < T_{x2}$,

the crystallization time of the first recording layer, t_{x1}, and the crystallization time of the second recording layer, t_{x2}, have the relationship $t_{x1} > t_{x2}$, and

$R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$ are different from one another where the resistance value of the first recording layer in the amorphous phase is R_{a1}, the resistance value of the first recording layer in the crystalline phase is R_{c1}, the resistance value of the second recording layer in the amorphous phase is R_{a2}, and the resistance value of the second recording layer in the crystalline phase is R_{c2}.

2. A memory according to claim 1, wherein the melting point of the first recording layer, T_{m1}, satisfies the relationship $400 \leq T_{m1}(°C) \leq 800$.

3. A memory according to claim 1, wherein the melting point of the second recording layer, T_{m2}, satisfies the relationship $300 \leq T_{m2}(°C) \leq 700$.

4. A memory according to claim 1, wherein the crystallization temperature of the first recording layer, T_{x1}, satisfies the relationship $130 \leq T_{x1}(°C) \leq 230$.

5. A memory according to claim 1, wherein the crystallization temperature of the second recording layer, T_{x2}, satisfies the relationship $160 \leq T_{x2}(°C) \leq 260$.

6. A memory according to claim 1, wherein the crystallization time of the first recording layer, t_{x1}, satisfies the relationship $5 \leq t_{x1}(ns) \leq 200$.

7. A memory according to claim 1, wherein the crystallization time of the second recording layer, t_{x2}, satisfies the relationship $2 \leq t_{x2}(ns) \leq 150$.

8. A memory according to claim 1, wherein:

the first recording layer includes three elements, Ge, Sb, and Te; and

the second recording layer includes (Sb-Te)-M1, where M1 is at least one selected from a group consisting of Ag, In, Ge, Sn, Se, Bi, Au, and Mn.

9. A memory according to claim 1, wherein the first recording layer is formed on a substrate, and the upper electrode is formed on the second recording layer.

10. A memory according to claim 9, wherein a lower electrode is formed between the substrate and the first recording

layer.

11. A memory according to claim 1, wherein an intermediate layer is formed between the first recording layer and the second recording layer.

12. A memory according to claim 1, wherein the specific resistance r_{a1} of the first recording layer in the amorphous phase is $1.0 \le r_{a1}(\Omega\cdot cm) \le 1\times10^{7}$.

13. A memory according to claim 1, wherein the specific resistance r_{a2} of the second recording layer in the amorphous phase is $2.0 \le r_{a2}(\Omega\cdot cm) \le 2\times10^{7}$.

14. A memory according to claim 1, wherein the specific resistance r_{c1} of the first recording layer in the crystalline phase is $1\times10^{-3} \le r_{c1}(\Omega\cdot cm) \le 1.0$.

15. A memory according to claim 1, wherein the specific resistance r_{c2} of the second recording layer in the crystalline phase is $1\times10^{-3} \le r_{c2}(\Omega\cdot cm) \le 1.0$.

16. A writing apparatus for writing information in a memory, the memory including:

a first recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse; and

a second recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current

pulse,

wherein the crystallization temperature of the first recording layer, T_{x1}, and the crystallization temperature of the second recording layer, T_{x2}, have the relationship $T_{x1} < T_{x2}$,

the crystallization time of the first recording layer, t_{x1}, and the crystallization time of the second recording layer, t_{x2}, have the relationship $t_{x1} > t_{x2}$, and

$R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$ are different from one another where the resistance value of the first recording layer in the amorphous phase is R_{a1}, the resistance value of the first recording layer in the crystalline phase is R_{c1}, the resistance value of the second recording layer in the amorphous phase is R_{a2}, and the resistance value of the second recording layer in the crystalline phase is R_{c2}, and

the writing apparatus including:

a pulse generator for generating at least first to third electric current pulses; and

an application section through which the at least first to third electric current pulses are applied to the first recording layer and the second recording layer,

wherein in order to change the first recording layer from the amorphous phase to the crystalline phase while the phase state of the second recording layer is kept unchanged, the pulse generator generates the first electric current pulse which provides a temperature (T) that satisfies $T_{x1} \leq T < T_{x2}$ during a time (t) that satisfies $t_{x1} \leq t$,

in order to change the second recording layer from the amorphous phase to the crystalline phase while the phase state of the first recording layer is kept unchanged, the pulse generator generates the second electric current pulse which provides a temperature (T) that satisfies $T_{x2} \leq T$ during a time (t) that satisfies $t_{x2} \leq t < t_{x1}$, and

in order to change both the first recording layer and the second recording layer from the crystalline phase to the amorphous phase, the pulse generator generates the third electric current pulse which provides a temperature equal to or higher than the higher one of the melting points of the first and second recording layers.

17. A writing apparatus according to claim 16, wherein the pulse amplitude of the first electric current pulse, I_{c1}, is $0.02 \leq I_{c1}(mA) \leq 10$, and the pulse width of the first electric current pulse, t_{c1}, is $5 \leq t_{c1}(ns) \leq 200$.

18. A writing apparatus according to claim 16, wherein the pulse amplitude of the second electric current pulse, I_{c2}, is $0.05 \leq I_{c2}(mA) \leq 20$, and the pulse width of the second electric current pulse, t_{c2}, is $2 \leq t_{c2}(ns) \leq 150$.

19. A writing apparatus according to claim 16, wherein the pulse amplitude of the third electric current pulse, I_{a1}, is $0.1 \leq I_{a1}(mA) \leq 200$, and the pulse width of the third electric current pulse, t_{a1}, is $1 \leq t_{a1}(ns) \leq 100$.

20. A writing apparatus according to claim 16, wherein, in order to change both the first recording layer and the second recording layer from the amorphous phase to the crystalline phase, the pulse generator generates a fourth electric current pulse which provides a temperature (T) that satisfies $T_{x2} \leq T$ during a time (t) that satisfies $t_{x1} \leq t$.

21. A writing apparatus according to claim 20, wherein the pulse amplitude of the fourth electric current pulse, I_{c12}, is $0.05 \leq I_{c12}(mA) \leq 20$, and the pulse width of the fourth electric current pulse, t_{c12}, is $5 \leq t_{c12}(ns) \leq 200$.

22. A writing apparatus according to claim 16, wherein, when the melting point of the first recording layer, T_{m1}, and the melting point of the second recording layer, T_{m2}, have the relationship $T_{m1} \neq T_{m2}$, in order to change the recording layer having the lower one of the melting points T_{m1} and T_{m2} from the crystalline phase to the amorphous phase while the phase state of the recording layer having the higher one of the melting points T_{m1} and T_{m2} is kept at the crystalline phase, the pulse generator generates a fifth electric current pulse which provides a temperature equal to or higher than the lower one of the melting points T_{m1} and T_{m2} and lower then the higher one of the melting points T_{m1} and T_{m2}.

23. A writing apparatus according to claim 22, wherein the pulse amplitude of the fifth electric current pulse, I_{a2}, is $0.05 \leq I_{a2}(mA) \leq 160$, and the pulse width of the fifth electric current pulse, t_{a2}, is $1 \leq t_{a2}(ns) \leq 100$.

24. A reading apparatus for reading information from a memory, the memory including:

a first recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse; and

a second recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature of the first recording layer, T_{x1}, and the crystallization

temperature of the second recording layer, T_{x2}, have the relationship $T_{x1} < T_{x2}$,

the crystallization time of the first recording layer, t_{x1}, and the crystallization time of the second recording layer, t_{x2}, have the relationship $t_{x1} > t_{x2}$, and

$R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$ are different from one another where the resistance value of the first recording layer in the amorphous phase is R_{a1}, the resistance value of the first recording layer in the crystalline phase is R_{c1}, the resistance value of the second recording layer in the amorphous phase is R_{a2}, and the resistance value of the second recording layer in the crystalline phase is R_{c2}, and

the reading apparatus including:

an application section through which an electric current pulse is applied to the first and second recording layers;

a resistance measurement device for measuring a sum of the resistances of the first and second recording layers; and

a determination section for determining which of the four different sums of resistance values, $R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$, the measured sum of the resistance values of the first and second recording layers is equal to.

25. A reading apparatus according to claim 24, wherein the electric current pulse has an amplitude I_r having a size such that a phase change is not caused in the first and second recording layers.

26. A reading apparatus according to claim 25, wherein the amplitude I_r of the electric current pulse is $I_r(mA) \leq 0.02$.

27. A memory, comprising

N recording layers (N is a natural number which satisfies $N > 2$) for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature T_{xm} of the m-th recording layer ($1 \leq m \leq N$) satisfies the relationship $T_{x1} < T_{x2} < \ldots < T_{xm-1} < T_{xm} < T_{xm+1} < \ldots < T_{xN}$,

the crystallization time t_{xm} of the m-th recording layer satisfies the relationship $t_{x1} > t_{x2} > \ldots > t_{xm-1} > t_{xm} > t_{xm+1} > \ldots > t_{xN}$, and

the resistance values of the N recording layers in the amorphous phase are different from one another, the resistance values of the N recording layers in the crystalline phase are different from one another, and the sum of the resistance values of the N recording layers is one of 2^N values.

28. A writing apparatus for writing information in a memory, the memory including

N recording layers (N is a natural number which satisfies $N > 2$) for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature T_{xm} of the m-th recording layer ($1 \leq m \leq N$) satisfies the relationship $T_{x1} < T_{x2} < \ldots < T_{xm-1} < T_{xm} < T_{xm+1} < \ldots < T_{xN}$,

the crystallization time t_{xm} of the m-th recording layer satisfies the relationship $t_{x1} > t_{x2} > \ldots > t_{xm-1} > t_{xm} > t_{xm+1} > \ldots > t_{xN}$, and

the resistance values of the N recording layers in

the amorphous phase are different from one another, the resistance values of the N recording layers in the crystalline phase are different from one another, and the sum of the resistance values of the N recording layers is one of 2^N values, and

the writing apparatus including:

a pulse generator for generating at least N crystallization pulses and amorphization pulse, and

an application section through which the at least N crystallization pulses and amorphization pulse are applied to the N recording layers,

wherein in order to change only the m-th recording layer from the amorphous phase to the crystalline phase while the phase states of the other recording layers are kept unchanged, the pulse generator generates a crystallization pulse which provides a temperature (T) that satisfies $T_{xm} \leq T_x < T_{x(m+1)}$ during a time (t) that satisfies $t_{xm} \leq t_x < t_{x(m-1)}$, and

in order to change all of the N recording layers from the crystalline phase to the amorphous phase, the pulse generator generates the amorphization pulse which provides a temperature equal to or higher than the highest one of the melting points of the N recording layers.

29. A writing apparatus according to claim 28, wherein, in order to change all of the N recording layers from the amorphous phase to the crystalline phase, the pulse generator generates an electric current pulse which provides a temperature (T) that satisfies $T_{xN} \leq T_x$ during a time (t) that satisfies $t_{x1} \leq t_x$.

30. A writing apparatus according to claim 28, wherein, in order to change the m-th to (m+n-1)th recording layers among

the N recording layers from the amorphous phase to the crystalline phase, the pulse generator generates an electric current pulse which provides a temperature (T) that satisfies $T_{x(m+n-1)} \leq T_x < T_{x(m+n)}$ during a time (t) that satisfies $t_{xm} \leq t_x < t_{x(m-1)}$.

31. A writing apparatus according to claim 28, wherein, when each of one or more recording layers among the N recording layers has a melting point equal to or lower than a temperature T_m, and each of the other recording layers among the N recording layers has a melting point higher than the temperature T_m, in order to change the one or more recording layers from the crystalline phase to the amorphous phase while the other recording layers are kept at the crystalline phase, the pulse generator generates an electric current pulse which produces the temperature T_m.

32. A reading apparatus for reading information from a memory, the memory including

N recording layers (N is a natural number which satisfies N > 2) for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature T_{xm} of the m-th recording layer ($1 \leq m \leq N$) satisfies the relationship $T_{x1} < T_{x2} < \ldots < T_{xm-1} < T_{xm} < T_{xm+1} < \ldots < T_{xN}$,

the crystallization time t_{xm} of the m-th recording layer satisfies the relationship $t_{x1} > t_{x2} > \ldots > t_{xm-1} > t_{xm} > t_{xm+1} > \ldots > t_{xN}$, and

the resistance values of the N recording layers in the amorphous phase are different from one another, the resistance values of the N recording layers in the

crystalline phase are different from one another, and the sum of the resistance values of the N recording layers is one of 2^N values, and

the reading apparatus including:

an application section through which an electric current pulse is applied to the N recording layers;

a resistance measurement device for measuring a sum of the resistances of the N recording layers; and

a determination section for determining which of the 2^N different values for the sum of resistance values the measured sum of the resistance values of the N recording layers is equal to.

33. A method for writing information in a memory, the memory including:

a first recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse; and

a second recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature of the first recording layer, T_{x1}, and the crystallization temperature of the second recording layer, T_{x2}, have the relationship $T_{x1} < T_{x2}$,

the crystallization time of the first recording layer, t_{x1}, and the crystallization time of the second recording layer, t_{x2}, have the relationship $t_{x1} > t_{x2}$, and

$R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$ are different from

one another where the resistance value of the first recording layer in the amorphous phase is R_{a1}, the resistance value of the first recording layer in the crystalline phase is R_{c1}, the resistance value of the second recording layer in the amorphous phase is R_{a2}, and the resistance value of the second recording layer in the crystalline phase is R_{c2}, and

the writing method including steps of:

generating at least first to third electric current pulses; and

applying the at least first to third electric current pulses to the first recording layer and the second recording layer,

wherein, in the step of generating the at least first to third electric current pulses, in order to change the first recording layer from the amorphous phase to the crystalline phase while the phase state of the second recording layer is kept unchanged, the pulse generator generates the first electric current pulse which provides a temperature (T) that satisfies $T_{x1} \le T < T_{x2}$ during a time (t) that satisfies $t_{x1} \le t$,

in order to change the second recording layer from the amorphous phase to the crystalline phase while the phase state of the first recording layer is kept unchanged, the pulse generator generates the second electric current pulse which provides a temperature (T) that satisfies $T_{x2} \le T$ during a time (t) that satisfies $t_{x2} \le t < t_{x1}$, and

in order to change both the first recording layer and the second recording layer from the crystalline phase to the amorphous phase, the pulse generator generates the third electric current pulse which provides a temperature equal to or higher than the higher one of the melting points of the first and second recording layers.

34. A method for reading information from a memory, the memory including:

a first recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse; and

a second recording layer for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature of the first recording layer, T_{x1}, and the crystallization temperature of the second recording layer, T_{x2}, have the relationship $T_{x1} < T_{x2}$,

the crystallization time of the first recording layer, t_{x1}, and the crystallization time of the second recording layer, t_{x2}, have the relationship $t_{x1} > t_{x2}$, and

$R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$ are different from one another where the resistance value of the first recording layer in the amorphous phase is R_{a1}, the resistance value of the first recording layer in the crystalline phase is R_{c1}, the resistance value of the second recording layer in the amorphous phase is R_{a2}, and the resistance value of the second recording layer in the crystalline phase is R_{c2}, and

the reading method including steps of:

applying an electric current pulse to the first recording layer and the second recording layer;

measuring a sum of the resistances of the first and second recording layers; and

determining which of the four different sums of resistance values, $R_{a1}+R_{a2}$, $R_{a1}+R_{c2}$, $R_{c1}+R_{a2}$, and $R_{c1}+R_{c2}$, the

measured sum of the resistance values of the first and second recording layers is equal to.

35. A method for writing information in a memory, the memory including

N recording layers (N is a natural number which satisfies $N > 2$) for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature T_{xm} of the m-th recording layer ($1 \leq m \leq N$) satisfies the relationship $T_{x1} < T_{x2} < \ldots < T_{xm-1} < T_{xm} < T_{xm+1} < \ldots < T_{xN}$,

the crystallization time t_{xm} of the m-th recording layer satisfies the relationship $t_{x1} > t_{x2} > \ldots > t_{xm-1} > t_{xm} > t_{xm+1} > \ldots > t_{xN}$, and

the resistance values of the N recording layers in the amorphous phase are different from one another, the resistance values of the N recording layers in the crystalline phase are different from one another, and the sum of the resistance values of the N recording layers is one of 2^N values, and

the writing method including steps of:

generating at least N crystallization pulses and amorphization pulse, and

applying the at least N crystallization pulses and amorphization pulse to the N recording layers,

wherein, in the step of generating the first to (N+1)th electric current pulses, in order to change only the m-th recording layer from the amorphous phase to the crystalline phase while the phase states of the other recording layers are kept unchanged, the pulse generator generates a crystallization pulse which provides a

temperature (T) that satisfies $T_{xm} \leq T_x < T_{x(m+1)}$ during a time (t) that satisfies $t_{xm} \leq t_x < t_{x(m-1)}$, and

in order to change all of the N recording layers from the crystalline phase to the amorphous phase, the pulse generator generates the amorphization pulse which provides a temperature equal to or higher than the highest one of the melting points of the N recording layers.

36. A method for reading information from a memory, the memory including

N recording layers (N is a natural number which satisfies $N > 2$) for recording information by utilizing a reversible phase change between a crystalline phase and an amorphous phase which occurs due to increases in temperature caused by application of an electric current pulse,

wherein the crystallization temperature T_{xm} of the m-th recording layer ($1 \leq m \leq N$) satisfies the relationship $T_{x1} < T_{x2} < \ldots < T_{xm-1} < T_{xm} < T_{xm+1} < \ldots < T_{xN}$,

the crystallization time t_{xm} of the m-th recording layer satisfies the relationship $t_{x1} > t_{x2} > \ldots > t_{xm-1} > t_{xm} > t_{xm+1} > \ldots > t_{xN}$, and

the resistance values of the N recording layers in the amorphous phase are different from one another, the resistance values of the N recording layers in the crystalline phase are different from one another, and the sum of the resistance values of the N recording layers is one of 2^N values, and

the reading method including steps of:

applying an electric current pulse to the N recording layers;

measuring a sum of the resistances of the N recording layers; and

determining which of the 2^N different values for the

sum of resistance values the measured sum of the resistance values of the N recording layers is equal to.